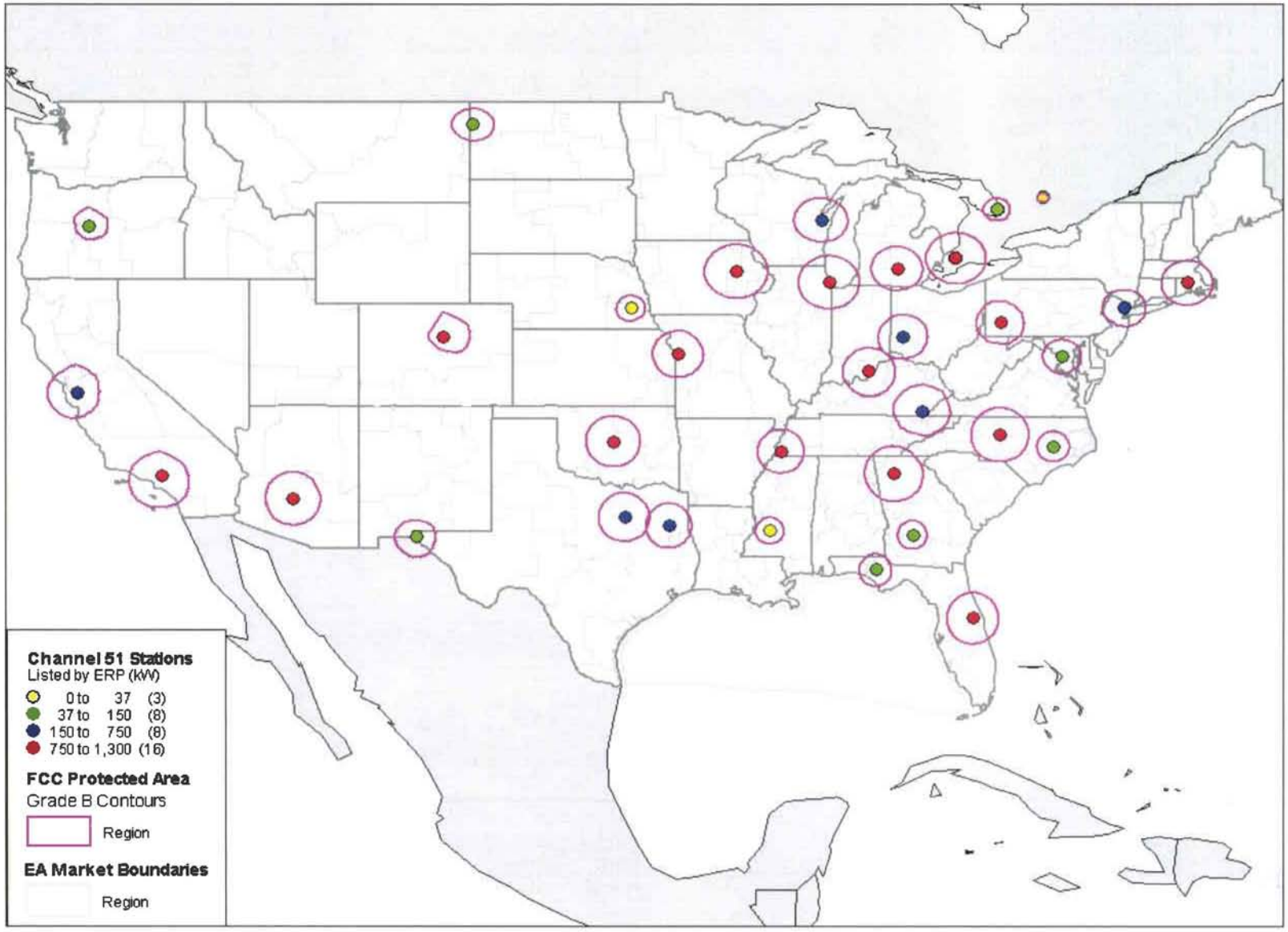
Opening Remarks

- **Multi-band Devices**
  - Primary Drivers
    - Capacity
    - International Roaming
  - Primary Challenges
    - Cost
    - Size
    - Performance
  - Primary Decision Criteria
    - Customer Demand
- **Additional Consideration for 700 MHz Lower A band**
  - Channel 51
  - Support CTIA Petition to Freeze Further Channel 51 Deployments

Channel 51 Full Power TV Stations (Licenses and Construction Permits)



Introduction

Edgar P Fernandes - Distinguished Member of the Technical Staff (Motorola Solutions)

Edgar has over 30 years experience in RF design, product development, systems engineering and regulatory approval (RF, EMC, PSTN and product safety) in the telecommunications industry.

He has actively participated in both ETSI and the 3GPP Standards Groups since 1990. He has been the 3GPP RAN4 Vice-Chair since 2007 and is the rapporteur of many work items in 3GPP including the UTRA (WCDMA) and (EUTRA) LTE device specifications. In this role he has contributed significantly to setting the RF performance requirements for the Global Cellular Industry.

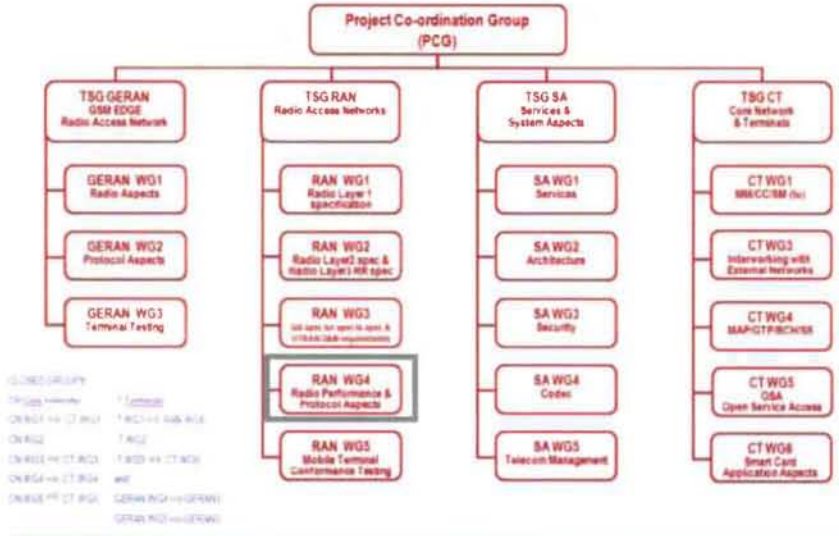
Edgar, who is based in the United Kingdom, holds a Bachelor of Science (Hons) in Electronic Engineering (specialisation in Communications) from The University of Southampton

3GPP Standardization Process

3GPP
A GLOBAL INITIATIVE

- 3GPP develops technical specifications on Mobile Broadband Systems
- The membership in 3GPP includes:
  - 372+ Individual Member companies,
  - Market Representation Partners,
  - Observer entities.
  - the 6 Global Organizational Partner or Standard Development Organizations below;

EU (ETSI) | Japan (ARIB, TTC) | Korea (TTA) | China (CCSA) | North America (atis)



RAN4 Radio performance and protocol aspects

- RAN WG4 (RAN4) works on the RF aspects of UTRAN / E-UTRAN.
- RAN4 performs simulations of diverse RF system scenarios and derives the minimum requirements for transmission and reception parameters, and for channel demodulation.
- Once these requirements are set, the group defines the test procedures that will be used to verify them (only for BS).
- Requirements for other radio elements, like Repeaters, are specified in the RAN4 as well

* New bands, co-existence, regional regulatory requirement

3GPP Operating bands

- **3GPP specified operating bands**
  - 34 Bands specified in 3GPP; America, Asia and Europe
  - 12 US Bands; 2, 4, 5, 12, 13, 14, 17, 23, 24, 25, 26 and 41
    Channel bandwidth of 1.4, 3, 5, 10, 15 and 20MHz
- **For local and international roaming**
  - GSM bands
  - WCDMA bands
  - LTE Band
  - + CDMA, WIMAX, iDEN, WLAN, Bluetooth and GPS
- **For LTE**
  - All devices must support 1 UL Tx path and 2 DL Rx path.
    3 RF front end components; TX/RX + RX for each band

E-UTRA operating bands							
Band	Uplink (UL) band BS receive /UE transmit FUL_low – FUL_high			Downlink (DL) band BS transmit /UE receive FDL_low – FDL_high			Duplex Mode
1	1920 MHz	–	1980 MHz	2110 MHz	–	2170 MHz	FDD
2	1850 MHz	–	1910 MHz	1930 MHz	–	1990 MHz	FDD
3	1710 MHz	–	1785 MHz	1805 MHz	–	1880 MHz	FDD
4	1710 MHz	–	1755 MHz	2110 MHz	–	2155 MHz	FDD
5	824 MHz	–	849 MHz	869 MHz	–	894MHz	FDD
6	830 MHz	–	840 MHz	875 MHz	–	885 MHz	FDD
7	2500 MHz	–	2570 MHz	2620 MHz	–	2690 MHz	FDD
8	880 MHz	–	915 MHz	925 MHz	–	960 MHz	FDD
9	1749.9 MHz	–	1784.9 MHz	1844.9 MHz	–	1879.9 MHz	FDD
10	1710 MHz	–	1770 MHz	2110 MHz	–	2170 MHz	FDD
11	1427.9 MHz	–	1447.9 MHz	1475.9 MHz	–	1495.9 MHz	FDD
12	698 MHz	–	716 MHz	728 MHz	–	746 MHz	FDD
13	777 MHz	–	787 MHz	746 MHz	–	756 MHz	FDD
14	788 MHz	–	798 MHz	758 MHz	–	768 MHz	FDD
15	Reserved			Reserved			FDD
16	Reserved			Reserved			FDD
17	704 MHz	–	716 MHz	734 MHz	–	746 MHz	FDD
18	815 MHz	–	830 MHz	860 MHz	–	875 MHz	FDD
19	830 MHz	–	845 MHz	875 MHz	–	890 MHz	FDD
20	832 MHz	–	862 MHz	791 MHz	–	821 MHz	FDD
21	1447.9 MHz	–	1462.9 MHz	1495.9 MHz	–	1510.9 MHz	FDD
23	2000 MHz	–	2020 MHz	2180 MHz	–	2200 MHz	FDD
24	1626.5 MHz	–	1660.5 MHz	1525 MHz	–	1559 MHz	FDD
25	1850 MHz	–	1915 MHz	1925 MHz	–	1990 MHz	FDD
26	814 MHz	–	849 MHz	859 MHz	–	894MHz	FDD
...							
33	1900 MHz	–	1920 MHz	1900 MHz	–	1920 MHz	TDD
34	2010 MHz	–	2025 MHz	2010 MHz	–	2025 MHz	TDD
35	1850 MHz	–	1910 MHz	1850 MHz	–	1910 MHz	TDD
36	1930 MHz	–	1990 MHz	1930 MHz	–	1990 MHz	TDD
37	1910 MHz	–	1930 MHz	1910 MHz	–	1930 MHz	TDD
38	2570 MHz	–	2620 MHz	2570 MHz	–	2620 MHz	TDD
39	1880 MHz	–	1920 MHz	1880 MHz	–	1920 MHz	TDD
40	2300 MHz	–	2400 MHz	2300 MHz	–	2400 MHz	TDD
41	2496 MHz	–	2690 MHz	2496 MHz	–	2690 MHz	TDD
42	3400 MHz	–	3600 MHz	3400 MHz	–	3600 MHz	TDD
43	3600 MHz	–	3800 MHz	3600 MHz	–	3800 MHz	TDD

Introduction

Edgar P Fernandes - Distinguished Member of the Technical Staff (Motorola Solutions)

Edgar has over 30 years experience in RF design, product development, systems engineering and regulatory approval (RF, EMC, PSTN and product safety) in the telecommunications industry.

He has actively participated in both ETSI and the 3GPP Standards Groups since 1990. He has been the 3GPP RAN4 Vice-Chair since 2007 and is the rapporteur of many work items in 3GPP including the UTRA (WCDMA) and (EUTRA) LTE device specifications. In this role he has contributed significantly to setting the RF performance requirements for the Global Cellular Industry.

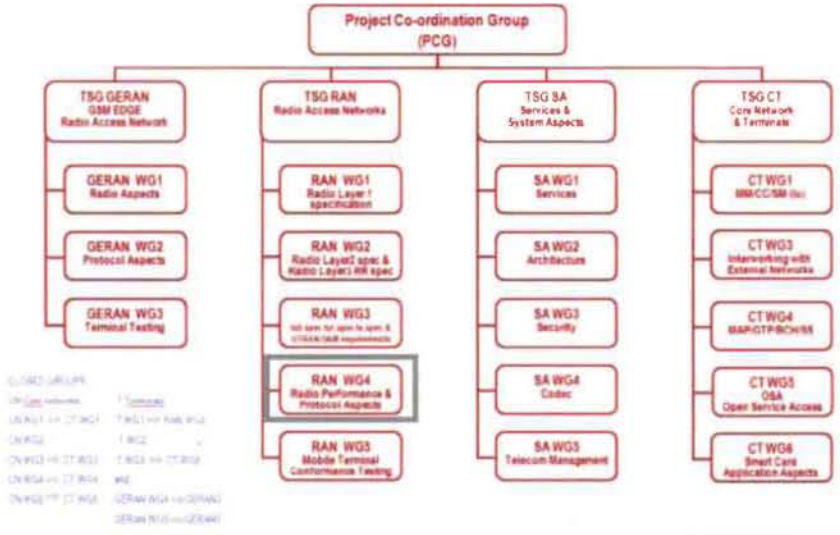
Edgar, who is based in the United Kingdom, holds a Bachelor of Science (Hons) in Electronic Engineering (specialisation in Communications) from The University of Southampton

3GPP Standardization Process

3GPP
A GLOBAL INITIATIVE

- 3GPP develops technical specifications on Mobile Broadband Systems
- The membership in 3GPP includes:
  - 372+ Individual Member companies,
  - Market Representation Partners,
  - Observer entities.
  - the 6 Global Organizational Partner or Standard Development Organizations below;

EU (ETSI) | Japan (ARIB, TTC) | Korea (TTA) | China (CCSA) | North America (atis)



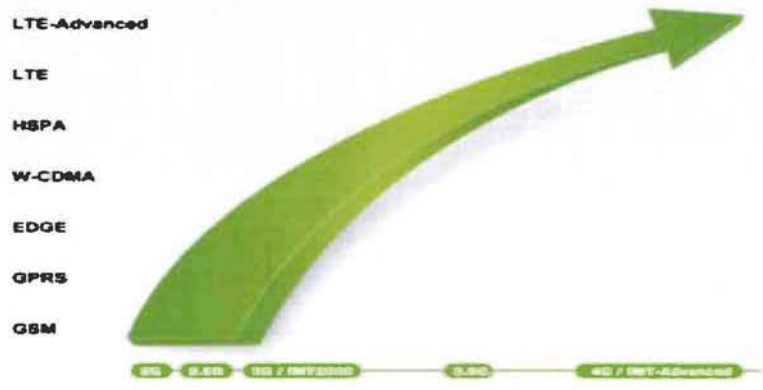
RAN4 Radio performance and protocol aspects

- RAN WG4 (RAN4) works on the RF aspects of UTRAN / E-UTRAN.
- RAN4 performs simulations of diverse RF system scenarios and derives the minimum requirements for transmission and reception parameters, and for channel demodulation.
- Once these requirements are set, the group defines the test procedures that will be used to verify them (only for BS).
- Requirements for other radio elements, like Repeaters, are specified in the RAN4 as well

* New bands, co-existence, regional regulatory requirement

3GPP Operating bands

- **3GPP specified operating bands**
  - 34 Bands specified in 3GPP; America, Asia and Europe
  - 12 US Bands; 2, 4, 5, 12, 13, 14, 17, 23, 24, 25, 26 and 41
    Channel bandwidth of 1.4, 3, 5, 10, 15 and 20MHz
- **For local and international roaming**
  - GSM bands
  - WCDMA bands
  - LTE Band
  - + CDMA, WIMAX, iDEN, WLAN, Bluetooth and GPS
- **For LTE**
  - All devices must support 1 UL Tx path and 2 DL Rx path.
    3 RF front end components; TX/RX + RX for each band



E-UTRA operating bands							
Band	Uplink (UL) band BS receive /UE transmit FUL_low – FUL_high			Downlink (DL) band BS transmit /UE receive FDL_low – FDL_high			Duplex Mode
1	1920 MHz	–	1980 MHz	2110 MHz	–	2170 MHz	FDD
2	1850 MHz	–	1910 MHz	1930 MHz	–	1990 MHz	FDD
3	1710 MHz	–	1785 MHz	1805 MHz	–	1880 MHz	FDD
4	1710 MHz	–	1755 MHz	2110 MHz	–	2155 MHz	FDD
5	824 MHz	–	849 MHz	869 MHz	–	894MHz	FDD
6	830 MHz	–	840 MHz	875 MHz	–	885 MHz	FDD
7	2500 MHz	–	2570 MHz	2620 MHz	–	2690 MHz	FDD
8	880 MHz	–	915 MHz	925 MHz	–	960 MHz	FDD
9	1749.9 MHz	–	1784.9 MHz	1844.9 MHz	–	1879.9 MHz	FDD
10	1710 MHz	–	1770 MHz	2110 MHz	–	2170 MHz	FDD
11	1427.9 MHz	–	1447.9 MHz	1475.9 MHz	–	1495.9 MHz	FDD
12	698 MHz	–	716 MHz	728 MHz	–	746 MHz	FDD
13	777 MHz	–	787 MHz	746 MHz	–	756 MHz	FDD
14	788 MHz	–	798 MHz	758 MHz	–	768 MHz	FDD
15	Reserved			Reserved			FDD
16	Reserved			Reserved			FDD
17	704 MHz	–	716 MHz	734 MHz	–	746 MHz	FDD
18	815 MHz	–	830 MHz	860 MHz	–	875 MHz	FDD
19	830 MHz	–	845 MHz	875 MHz	–	890 MHz	FDD
20	832 MHz	–	862 MHz	791 MHz	–	821 MHz	FDD
21	1447.9 MHz	–	1462.9 MHz	1495.9 MHz	–	1510.9 MHz	FDD
23	2000 MHz	–	2020 MHz	2180 MHz	–	2200 MHz	FDD
24	1626.5 MHz	–	1660.5 MHz	1525 MHz	–	1559 MHz	FDD
25	1850 MHz	–	1915 MHz	1925 MHz	–	1990 MHz	FDD
26	814 MHz	–	849 MHz	859 MHz	–	894MHz	FDD
...							
33	1900 MHz	–	1920 MHz	1900 MHz	–	1920 MHz	TDD
34	2010 MHz	–	2025 MHz	2010 MHz	–	2025 MHz	TDD
35	1850 MHz	–	1910 MHz	1850 MHz	–	1910 MHz	TDD
36	1930 MHz	–	1990 MHz	1930 MHz	–	1990 MHz	TDD
37	1910 MHz	–	1930 MHz	1910 MHz	–	1930 MHz	TDD
38	2570 MHz	–	2620 MHz	2570 MHz	–	2620 MHz	TDD
39	1880 MHz	–	1920 MHz	1880 MHz	–	1920 MHz	TDD
40	2300 MHz	–	2400 MHz	2300 MHz	–	2400 MHz	TDD
41	2496 MHz	–	2690 MHz	2496 MHz	–	2690 MHz	TDD
42	3400 MHz	–	3600 MHz	3400 MHz	–	3600 MHz	TDD
43	3600 MHz	–	3800 MHz	3600 MHz	–	3800 MHz	TDD

700 MHz INTEROPERABILITY WORKSHOP
Presentation

RM-11592

April 26, 2011

Dennis Martinez – Chief Technology Officer,
Harris RF Communications Division,
Harris Corporation

Interoperability of Customer Mobile Equipment Across Commercial Spectrum Blocks in the 700 MHz Band April 26, 2011

Dr. Dennis Martinez
Chief Technology Officer
Harris RF Communications Division

Public Safety Communications: System Evolution

HARRIS

Today → Mid-Term → Long -Term

Multiple Technologies Disparate Networks

- LMR & Paging Systems

- Commercial Cellular Data Services

Hybrid Network

- Legacy LMR & Paging Systems
- Voice Interoperability
- 700 MHz Public Safety LTE Network
- • Roaming
  • Asset Leverage
  • Services
- Commercial Cellular Data Services (3G & 4G)

Converged Network

National Public Safety LTE Network Supports:

- •Mission Critical Voice & Data
- •Nation-wide Roaming
- •Public Safety Grade – Availability & Service Levels
- •Interoperability with Relevant Alternate Technologies

Key Market Issues for 700 MHz Public Safety Equipment

HARRIS

- Public safety is facing two technology migrations
  - Private narrowband voice systems to Voice-Over-LTE
  - Public carrier cellular data services to dedicated LTE V+D network
- Migration and interoperability are interwoven
  - Migration involves interoperation with legacy technologies & systems
  - Emerging interoperability framework for inter-carrier roaming between commercial and dedicated 700 MHz LTE networks
- Emerging regulatory framework
  - Governance Structure and System Architecture
  - 3rd R&O codifies LTE as the 700 MHz standard
  - Ongoing Fourth FNMRM
  - Public policy issues related to allocation of upper D-Block to Public Safety
- Multiple emerging business models
  - Dedicated Networks ↔ Fully Shared, Retail
- Public Safety is not a commercial business
  - It is a collection of mission-oriented enterprises chartered with protecting life and property
  - Service levels (coverage, availability, security etc.) are not based on commercial value
  - Challenge/opportunity is to leverage commercial technology while retaining mission-focus

Public Safety Broadband Network Business Models

HARRIS

Infrastructure Oriented ← → *Service Oriented*

	Dedicated Network	Dedicated Radio Access Network	Dedicated Channel	Fully Shared, Enterprise	Fully Shared, Retail
Description	• PS has separate base stations, backhaul and core network	• PS has separate base stations, uses carrier core network	• PS uses carrier RAN and core, with line card for PS spectrum	• PS uses carrier network for data transport, adds service layer	• PS relies on carrier network for data transport and services
Business Model	• Contract to build and manage network	• Contract for RAN OA&M • Tonnage fees for core services	• Install subsidy for channel card • Tonnage fees for core services	• Tonnage fees	• User / service fees
Advantages	• Maximum PS control, flexibility, and dedicated capacity	• PS can specify RAN req's, dedicated RAN capacity	• Dedicated RAN capacity, cost-efficient	• High cost efficiency, service level flexibility	• High cost efficiency, operational simplicity
Disadvantages	• High PS cost and complexity	• RAN cost redundancies	• Some limits on feature flexibility	• No dedicated capacity	• No dedicated capacity, less service flexibility, higher user fees

Source: The Public Safety Broadband Wireless Network:
21st Century Communications for First Responders
Public Safety Homeland Security Bureau
Federal Communications Commission
Tuesday, March 9, 2010

Further Comments

HARRIS

- Public Safety is not a monolithic market
  - Diverse governance structure – States, Local, Tribal & Federal
  - Jurisdictional needs vary across states, large cities and rural areas
  - Mission requirements vary between first responders (law enforcement, fire service, EMS)
  - Complex funding mechanisms

- Public safety traditionally has very long market cycles for introduction of new technologies
  - Alignment with commercial technologies will create opportunities to improve this
  - New challenges will be created to synchronize the whole market to commercial technology evolution (Rel. 8, Rel. 9, etc.)